Ch.2 Con Q 5,7,8
Ch.2 Probs 5,6,8

14/15

PHYS-131 10:00 A.M Taylor Larrechea

Conceptual Questions

5 a.) At the instant t=1s, A has a greater speed than B because the line A has a steeper positive slope. The steeper slope signifies more position being covered in a time interval and furthermore a greater speed. A slightly shallower slope signifies less position being covered in the same interval coinciding in a slower speed.

b.) It appears at time t=3 A and B have the same speed because their slopes are the same.

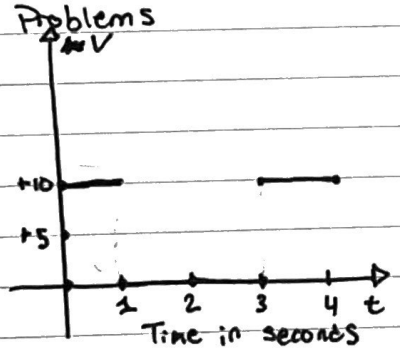
7 a.) C
b.) F
C.) B
d.) E, A

8 a.) In frame 3 and in frame 6 the cars A & B have the same position

b.) Between 4 and 5 frames they have the same velocity

Ch 2. Problems

5 a.)



t=0	t=1	t=2	t=3	t=4
m=0	m=10	m=10	m=10	m=10
m=0	m=10	m=10	m=10	m=20

b.) No it doesn't have a turning point.

6 a.) It has a turning point at $t=1s$ acceleration $4 m/s^2$

b.) $t=2$, 10 → Position
$t=4$, 26 → Position

$P=2x^2-4x+C$ $V=4x+C$

$x=2t^2-4t+10$ $V=4x-4$

8 $x_0=0m$ $t_0=0s$ $0 \le t \le 4$

$x=35$ m $2.5 m/s^2$

$A=-2.5$ $V=-2.5t+C$ $35=1.25t^2$

$V=-2.5t+C$ $V=2.5t$ $28=t^2$

$V=-2.5T+10$ $P=1.25t^2+C$ $t=2\sqrt{7}$

$P=-1.25T^2+10T+C$ $P=1.25t^2$ 5.2915

$P=-1.25T^2+10T+20$

$35=-1.25T^2+10T+20$

$15=-1.25T^2+10T$

$0=-1.25T^2+10T-15$

$T=2$

At times $t=6$ ✓
$t=10$ ✓
the particle is at $x=35$ m

How do these give? (-1)

just use areas. $2/3$

$-1.0-(-1.75)$ $0.25-(-1.0)$
$-1.0+1.75$ $0.25+1.0$

$\frac{x_f-x_i}{T_f-T_i}$

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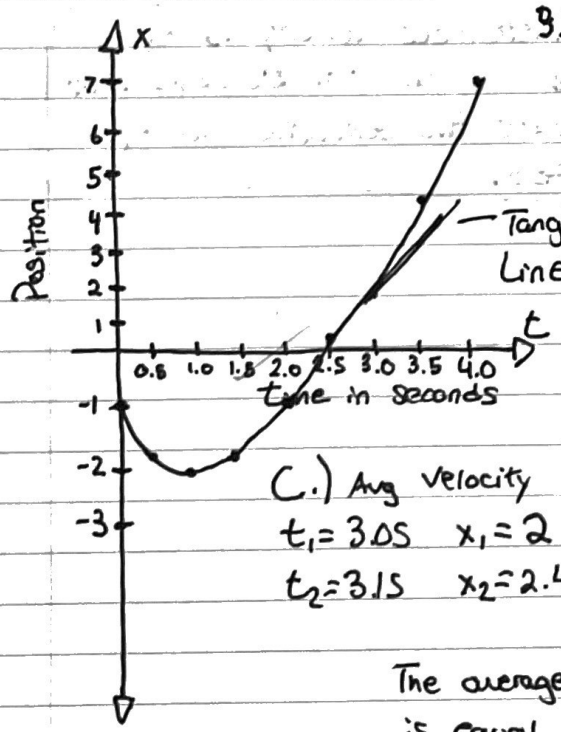
Supplementary Exercises

7 $x=t^2-2t-1$ a)

t_i	t_f	Δt	x_i	x_f	Δx	velocity avg $\frac{\Delta x}{\Delta t}$
0.0s	0.5s	0.5s	-1.0	-1.75	0.75	1.5 w/s units/second
0.5s	1.0s	0.5s	-1.75	-2.0	0.25	0.5 w/s
1.0s	1.5s	0.5s	-2.0	-1.75	+0.25	0.125 w/s
1.5s	2.0s	0.5s	-1.75	-1.0	0.75	1.5 w/s
2.0s	2.5s	0.5s	-1.0	0.25	1.25	2.5 w/s
2.5s	3.0s	0.5s	0.25	2.0	1.75	3.5 w/s
3.0s	3.5s	0.5s	2.0	4.25	2.25	4.5 w/s
3.5s	4.0s	0.5s	4.25	7.0	2.75	5.5 w/s



b.) Velocity at 3.0 s is = 4.0 w/s

$\frac{4.5+3.5}{2} = \boxed{4}$ t^2-2t-1

$\frac{dt}{dx} = 2t-2$

$\frac{t_f+t_i}{2}$ = velocity $(3.0)=2(3.0)-2$

$6-2=4$

$\frac{3.0s+3.0s}{2} = \frac{3.5\ w/s + 4.5\ w/s}{2}$

C.) Avg velocity of $t=3.0s$ $t=3.1s$ x_2-x_1

$t_1=3.0s$ $x_1=2$ $\frac{\Delta x}{\Delta t}$ = Avg velocity $\frac{2.41-2}{3.1-3.0} = \frac{0.41}{0.1} = 4.1$

$t_2=3.1s$ $x_2=2.41$ t_2-t_1

The average velocity over the time interval $3.0_s-3.1_s$ is equal to $\boxed{4.1\ w/s}$

units per second

D.) Avg velocity over 3.00 s - 3.01s

$t_1=3.00s$ $x_1=2$ $\frac{\Delta x}{\Delta t} = \frac{2.0401-2}{3.01-3.00} = \frac{0.0401}{0.01} = 4.01$

$t_2=3.01s$ $x_2=2.0401$

The average velocity over the time interval $3.00_s-3.01_s$ is equal to $\boxed{4.01\ \frac{\text{units}}{\text{second}}}$

E.) As the average velocity approaches 3.0s it appears to reach a limit of 4.

F.) $x = t^2 - 2t - 1$

$\frac{dx}{dt} = 2t - 2$

$x'(3) = 2(3) - 2$

$6 - 2$

4

3.0s

The velocity of the position function at time 3.0s is 4 $\frac{\text{units}}{\text{second}}$. It does agree with my previous part. ✓

6.) $x = t^2 - 2t - 1$

$\frac{dx}{dt} = 2t - 2$

$0 = 2t - 2$

$2 = 2t$

$t = 1$

The instaneous velocity is equal to zero when $t = 1$ because that is where the derivative is equal to zero.

3/3

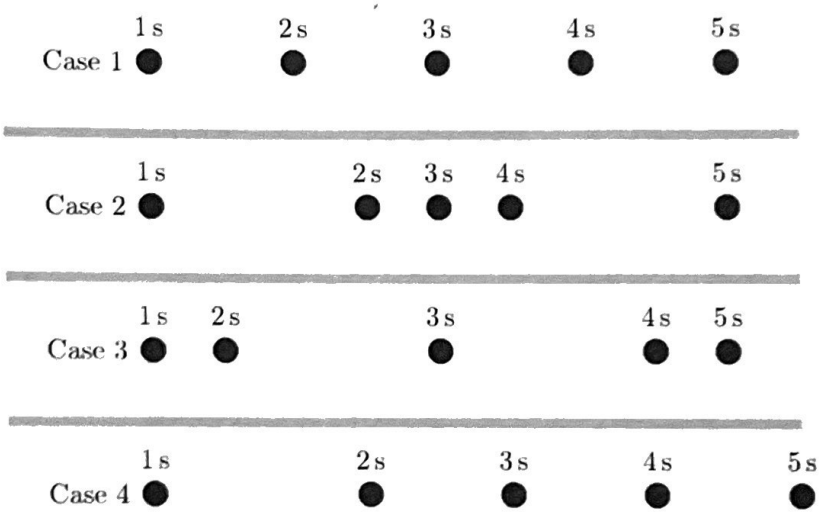
Taylor Larrechea

Phys 131
Fall 2016

Phys 131: Supplementary Exercises

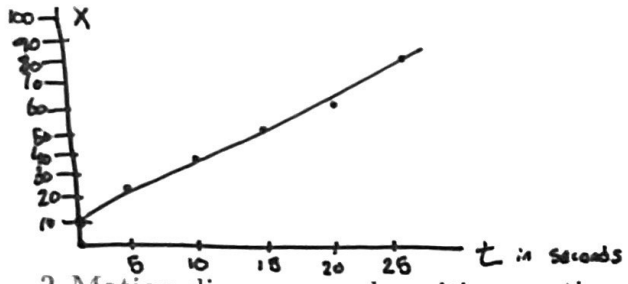
1 Motion diagrams: horizontal motion

A car moves to the right. For an initial period it slows down and after that it speeds up. Which of the following (choose one) best represents its location as time passes?



Briefly explain your choice.

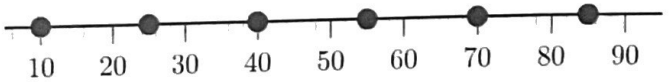
Case 2 is my choice because the distance between the dots in the middle decrease in length so ∴ it must represent slowing down.



2 Motion diagrams and position vs. time graphs

A car moves from left to right and its position, measured in meters, is recorded every 5.0 s. The resulting motion diagram is illustrated.

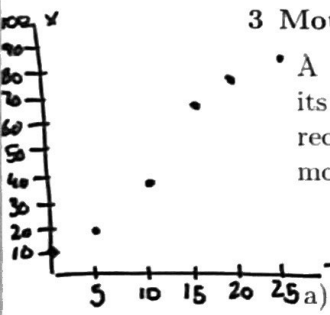
time(s)	Position (meters)
0	10
5.0	25
10.0	40
15.0	55
20.0	70
25.0	85



a) Produce a table of numerical data for position versus time for the car for the duration of the motion.

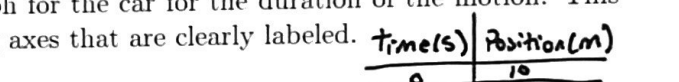
b) Produce a position versus time graph for the car for the duration of the motion. This graph must be drawn by hand using axes that are clearly labeled.

3 Motion diagrams and position vs. time graphs



A car moves from left to right and its position, measured in meters, is recorded every 5.0 s. The resulting motion diagram is illustrated.

time(s)	Position(m)
0	10
5.0	20
10.0	40
15.0	70
20.0	80
25.0	85

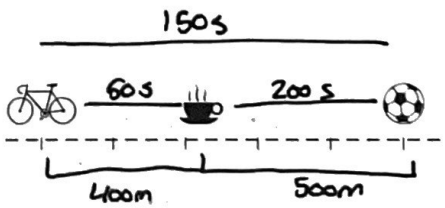


a) Produce a table of numerical data for position versus time for the car for the duration of the motion.

b) Produce a position versus time graph for the car for the duration of the motion. This graph must be drawn by hand using axes that are clearly labeled.

4 Average velocity

The following objects lie along a straight line: a bicycle, a coffee cup and a soccer ball. The distance from the coffee cup to the bicycle is 400 m and from the cup to the ball is 500 m. A man starts at the cup and travels in a straight line to the ball. This takes 200 s. A dog is initially at the cup and runs at constant speed to the bicycle, taking 50 s to do so. The dog immediately turns around and runs to ball; this takes the dog an additional 150 s. Consider the entire trip from the cup to the ball for each. Who has the larger average velocity for this entire trip? Explain your answer.



$v_{man} = \frac{500\ m}{200\ s} = 2.5\ m/s$

$v_{dog} = \frac{900\ m}{200\ s} = 4.5\ m/s$

The dog has a larger average velocity because it travels 400 m more than the man in the same time interval. (200 s)

Taylor Larrechea

7 Velocity as a derivative

An atom is trapped in such a way that it can move back and forth along one straight line. Its position is tracked as time passes and is represented by the function $x = t^2 - 2t - 1$.

a) Produce a list of positions at every 0.5 s from $t = 0.0\,\text{s}$ to $t = 4.0\,\text{s}$. Use this data to plot an accurate graph of position versus time for $t = 0.0\,\text{s} \leqslant t \leqslant 4.0\,\text{s}$. *The graph must be drawn accurately enough to draw and calculate slopes of tangent lines.*

b) Determine the velocity of the atom at 3.0 s by using a tangent line construction for the graph of position versus time.

The aim of the next parts of this problem is to determine the instantaneous velocity at 3.0 s.

c) Use the function of position versus time to determine the average velocity over the time interval from $t = 3.0\,\text{s}$ to $t = 3.1\,\text{s}$.

d) Use the function of position versus time to determine the average velocity over the time interval from $t = 3.00\,\text{s}$ to $t = 3.01\,\text{s}$.

e) Does the value of average velocity at 3.0 s appear to approach a limit as the time interval decreases? If so what does the limit appear to be?

f) Use the derivative of position to determine the exact instantaneous velocity at 3.0 s. Does the result agree with your answer to the previous part?

g) At what time is the instantaneous velocity exactly zero? Explain your answer.